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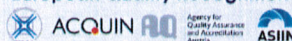


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ИССЛЕДОВАНИЯ КАМЕЛИДОВ  
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ISSN 1999-3951



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камелидов для устойчивого развития ”  
8-12 июня, 2015 Алматы, Казахстан

Special issue of Scientific and Practical Journal Veterinariya #2 (42) 2015  
«Ғылыми және практикалық Ветеринария» журналының арнайы нөмірі №2 (42) 2015  
Специальный номер научно-практического журнала «Ветеринария» №2 (42) 2015

Almaty, 2015



**Editor in chief – G. Konuspayeva/Главный редактор – Конуспаева Г.С.**

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ISSN 1999-3951

ISSN 1999-3951

Citation of the Proceedings as « Special Issue of Scientific and Practical Journal Veterinariya #2 (42) 2015 »

© Научно-практический журнал «Ветеринария», 2015  
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## IMPACT OF TRANSPORT DISTANCE ON STRESS BIOMARKERS LEVELS IN DROMEDARY CAMEL (*CAMELUS DROMEDARIUS*).

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### Abstract

The welfare conditions of domestic animals during transport to the slaughterhouse are largely known able to influence the level of their stress, physiology and meat quality. Furthermore, the reaction of animals to stressors depends on the duration and intensity of these stressors. The objective of the study was to investigate the effect of transport distance on some blood physiological indicators of stress (haematocrit, haemolysis, cortisol, glucose and lactate) and biomarkers of oxidant stress (malondialdehyde and catalase) in camels. Transport distances were categorized as short (72-80km), medium (160-170km) and long (350-360km) distance. All parameters analyzed here increased gradually and significantly ( $P<0.05$ ) with transport distance, and that over longer distances these responses were more significant ( $P<0.005$ ) compared with short-distance. A positive correlation ( $P<0.001$ ) was obtained between cortisol, glucose, lactate, malondialdehyde and catalase. As conclusion, road transport is very stressful in camel, and the effects of this stress on the relevant indicators rising much with distance. Future work should focus on the effect of transport distance on some quality indicators of camel meat.

**Key words:** camel, haemolysis, oxidant stress, road transport, stress responses.

## ДРОМЕДАР ТҮЙЕЛЕРДІҢ (*CAMELUS DROMEDARIUS*) ЖОЛ ЖҰРУ ҚАШЫҚТЫҒЫНЫҢ СТРЕСС БИОМАРКЕРЛЕРІНІҢ ДӘРЕЖЕСІНЕ ӘСЕРІ

Үй жануарлары қасапханаға дейін жол жүру кезіндегі жағдайлары олардың стресс дәрежесіне, физиологиясына және ет сапасына қатты әсер ететіні белгілі. Сонымен қатар, жануардың бұл құлқы стрессорлардың ұзақтығы мен интенсивтілігіне тікелей байланысты. Бұл жұмыстың мақсаты жол жүру қашықтығының қандағы стрестің кейбір индикаторлары (гематокрит, гемолиз, кортизол, глюкоза и лактат) мен стресс тотығының биомаркерлеріне (малондальдегид и каталаза) әсерін зерттеу. Жол жүру қашықтығы үш топқа : қысқа (72-80 км), орташа (160-170 км) және ұзық (350-360 км) бөлініп жіктелді. Мұнда сарапталған барлық факторлар жол жүру қашықтығының өсуімен бірте-бірте және айтарлықтай өсті ( $P<0.05$ ), ұзақ қашықтықтарда қысқа қашықтықтарға қарағанда жануарлардың бұл құлқы айтарлықтай болды ( $P<0.05$ ). Кортизол, глюкоза, лактат, малондальдегид және каталаза бойынша оң корреляция алынды ( $P<0.001$ ). Қорыта келе, түйелер үшін өте стресті болып келетін жол жүру процессі кезінде оларға максималды жағдай жасау керек. Келесі жұмыста біз жол жүру уақытының түйе еті кейбір сапалы индикаторларына әсерін зерттейтін боламыз.

**Түйін сөздер:** Түйе, Гемолиз, Стресс тотығы, Жол жүру көлігі, Стресске жауап.

## ЭФФЕКТ СЕЗОНА ЗАБОЯ НА ЖИРНО-КИСЛОТНЫЙ СОСТАВ МЯСА ВЕРБЛЮДОВ ПУСТЫНИ (*CAMELUS DROMEDARIUS*)

В настоящей работе было исследовано влияние сезона забоя на жирно-кислотный состав мышцы LT туши верблюда. В Судане из группы из тридцати верблюдов пустыни, выпасаемых различными верблюдоводами, в разные времена года забивалось по 10 животных в разные сезоны года: зимой, летом и осенью. Полученные результаты показали, что средние значения липидов в трех сезонах составило 11,7 г/100г свежей мышцы, не показали никаких различий между сезонами. LT мышцы содержали 52,2% НЖК, 35,8% МНЖК, 11,6 ПНЖК и 0,5% CLA, соответственно. Влияние сезона забоя на общий состав и высокое содержание МНЖК обнаружено летом по

сравнению с другими сезонами, кроме того, наблюдалось высокое соотношение 18:2 n-6/18:3 n-3, n-6/n-3 жирных кислот, а также НЖК/НЖК в зависимости от сезона забоя ( $P < 0,05$ ). Состав CLA и процентное содержание транс-11, цис-9 18:2 изомеров являются относительно высокими, в то время как соотношение n-6/n-3 было в пределах рекомендуемых значений для питания человека, ЛТ мышцы верблюдов не теряют питательную ценность в течение года.

**Ключевые слова:** жирные кислоты, сезон убоя, мясо верблюда, питательная ценность

### Introduction

During environmental stress, marked changes in the levels of reactive oxygen species scavengers occurred in the serum of camels (Kataria et al., 2010). As a very stressful factor, road transport of camels to the slaughterhouse is able to induce hypercortisolaemia (Saeb et al., 2010; El Khasmi et al., 2013) and may lead to an increase of free radical generation (Nazifi et al., 2009). Furthermore, the reaction to transport stress may have an impact on the quality of slaughtered animal meat and depends on the duration and intensity of this stressor (Malena et al., 2006; DeSilva and Kalubowila, 2012). The objective of the study was to investigate the effect of transport distance on some circulating indicators of stress: haematocrit (Ht), haemolysis (H), cortisol (Cor), glucose (Glu) and lactate (Lac), and two biomarkers of oxidant stress: malondialdehyde (MDA) and catalase (Cat) in camels.

### Materials and methods

Three groups of 6 male camels: group I, group II and group III (6 to 9 years of age) were transported respectively from Settat (72-80 km), Fqih Ben Saleh (160-170 Km) and Essaouira (350-360) to Casablanca Municipality slaughterhouse. At the end of road transport, blood samples were collected with and without EDTA, Ht was determined and erythrocytes suspensions were prepared and stored at 4°C for 24h until analysis of H (O'Dell et al., 1987). H was analyzed by measuring the absorbance of supernatant at 540 nm after incubation of erythrocytes in different phosphate buffered saline (pH 7.4) concentrations, ranging from 0.1% to 0.9%. Sera were collected then stored at -20°C until analysis. Glu and Lac were measured using commercially available kits. Cor was analyzed by radioimmunoassay method in CNESTEN, Morocco, by using DIALsource Kit. MDA was measured by a colorimetric method (Satho, 1978). The Cat activity was measured as the  $\mu\text{mol}$  decreased  $\text{H}_2\text{O}_2/\text{min}/\text{mg}$  protein (Aebi, 1974). The amount of total proteins was determined using Biuret method. The data were analyzed by the Mann-Whitney U test for comparison between groups. The degree to which variables were related is measured with Pearson's correlation. P values greater than 0.05 were considered insignificant.

### Results and discussions

In the work reported here, stress indicators increased gradually and significantly ( $P < 0.05$ ) with transport distance, and that over longer distances these responses were more significant ( $P < 0.005$ ) compared with short-distance (Table 1). In addition, a positive correlation ( $P < 0.001$ ) was obtained between Cor, Glu, Lac, MDA and Cat.

Table 1. Effects of road transport distance on some stress indicators in dromedary camels. ( $M \pm ET$ ,  $n = 6$  camels/group,  $^*P < 0.05$ ,  $^{**}P < 0.005$  comparison between long-distance and short-distance).  $\text{H}_{50}$ : Phosphate buffered saline concentration inducing haemolysis of 50% of erythrocytes.

| Stress indicators         | Group I<br>72-80 Km | Group II<br>160-170 Km | Group III<br>350-360 Km |
|---------------------------|---------------------|------------------------|-------------------------|
| Haematocrit (%)           | $39.17 \pm 1.17$    | $41.17 \pm 1.47$       | $43.17 \pm 0.98^*$      |
| $\text{H}_{50}$ (mosm/L)  | $132.65 \pm 3.99$   | $135.98 \pm 6.33$      | $147.65 \pm 3.99^*$     |
| Glucose (mmol/L)          | $5.07 \pm 0.28$     | $7.08 \pm 0.21$        | $9 \pm 0.35$            |
| Lactate (mmol/L)          | $9.97 \pm 0.31$     | $12.99 \pm 0.16$       | $14.88 \pm 0.29$        |
| Malondialdehyde (nmol/mL) | $1.58 \pm 0.38$     | $3.88 \pm 0.20^*$      | $6.44 \pm 0.52^{**}$    |
| Catalase (KU/L)           | $60.08 \pm 3.18$    | $79.13 \pm 3.84^*$     | $93.95 \pm 3.62^{**}$   |

In camel, transportation stress can induce an increase of Cor, Ht, Glu and H (El Khasmi et al., 2013). The increase in the Glu and Lac related to fuel homeostasis, be explained by hepatic glucose production and an increase in the rate of gluconeogenesis. This response was mediated by an activation of the hypothalamo-hypophysis-adrenal axis during transport stress which induced a release of Cor and catecholamines. In addition, this release may reduce the preslaughter amount of glycogen then affect the *postmortem* biochemical evolution in muscle. The increase in the serum levels of stress biomarkers associated with the increasing travel distance observed here, has been reported by other investigation in other domestic species (Malena et al., 2006; DeSilva and Kalubowila, 2012). An increase in free-radical generation as a result of stress may be responsible of the high levels of MDA and Cat observed here, resulting oxidative damage of the erythrocytes membrane (Nazifi et al., 2009). Oxidative alterations of camel erythrocytes may be attenuated by incubation with vitamins A and/or C (Chakir et al., 2013). As conclusion, since the effect of transport distance is very stressful in camel, the maximum care should be taken during this process. Future work should focus on the effect of transport time on some quality indicators of camel meat.

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#### Acknowledgments

The author thank the President of urban municipalities of Casablanca and the Director and the responsible for veterinary of Casablanca slaughterhouse, to carry out this work.

## EFFECT OF ADDING GRANGAL ON COMPOSITIONAL QUALITY OF CAMEL MILK CHEESE DURING STORAGE

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#### Abstract

This study was based on using Grangal to improve fermentation of camel milk. The cheese was made using FAR-M as a coagulant for camel (control cheese) in addition a parallel cheese was made after addition of 1% Grangal (Grangal cheese). Both cheeses were processed using the same condition and they were compared for 3 weeks. Higher cheese yield (8.85% vs. 7.35%) and higher total solids, protein, fat and ash were found for Grangal cheese (60.48, 27.15, 2828 and 9.52 %) compared to control cheese (52.64, 23, 26 and 8.53%). All the compositional content revealed reduction for both cheeses during the storage. However the acidity of the cheese to which Grangal was added showed higher value during the first week of storage compared to the control cheese, while lower values were observed thereafter. The present result suggested the use of additives; especially those that used indigenously by camel herders as they long traditional and rich knowledge about their habitat; in order to improve and enhance camel milk cheese processing.

*Key words: camel milk, cheese, Grangal, storage, constituents*

## САҚТАУ КЕЗІНДЕГІ ТҮЙЕ СҮТІНЕН ДАЙЫНДАЛҒАН ІРІМШІКТІҢ КОМПОЗИЦИЯЛЫҚ САПАСЫНА GRANGAL ҚОСУДЫҢ ӘСЕРІ

Бұл зерттеу түйе сүтін ашытуын жақсарту үшін Grangal пайдалануға негізделген болатын. Ірімшіктер, түйе сүтіне коагулянт ретінде FAR-M (бақылау ірімшік) және 1% Grangal (Grangal ірімшік) қосу арқылы дайындалынған. Екі ірімшік бірдей жағдайда өңделді және олар 3 апта бойы салыстырылды. Ірімшіктің артығырақ шығуы (8,85% қарсы 7,35%) және жалпы қатты заттар, ақуыз, май және күл жоғары, Grangal ірімшік үшін табылған (60.48, 27.15, 2828 және 9,52%) бақылау ірімшікпен салыстырғанда (52.64, 23, 26 және 8,53%). Барлық композициялық мазмұны сақтау кезінде екі ірімшік төмендеу анықталды. Төменгі мәндер содан кейін байқалады, алайда Grangal қосылғанда, оған ірімшік қышқылдығы, бақылау ірімшік салыстырғанда сақтаудың бірінші аптасында жоғары мән көрсетті. Қазіргі нәтижесі келесі қоспаларды қолдануды ұсынды: олар тіршілік ету ортасы туралы дәстүрлі және бай білімді ұзақ жылдар бойы түйе сүті ірімшік өңдеуді жақсарту және арттыру мақсатында түйе малшылары ежелден пайдаланылатын.

*Түйін сөздер: түйе сүт, ірімшік, Grangal, сақтау, үшжақты*

## ЭФФЕКТ ДОБАВЛЕНИЯ ГРАНГАЛА НА КАЧЕСТВО СОСТАВА ВЕРБЛЮЖЬЕГО СЫРА ВО ВРЕМЯ ХРАНЕНИЯ

Это исследование было основано на использовании грангала для улучшения брожения верблюжьего молока. Сыры были изготовлены с использованием FAR-M в качестве коагулянта (контрольный сыр) и с добавлением 1% грангала (грангальный сыр). Оба сыра были обработаны в одинаковых условиях и сравнивались в течение 3 недель. Большой выход сыра (8,85% против 7,35%) и большее количество твердых веществ, белков, жиров и золы были обнаружены в грангальном сыре (60.48, 27.15, 2828 и 9,52%) по сравнению с контрольным сыром (52,64, 23, 26 и 8,53%). Все составные обоих сыров показали снижение при хранении. Однако кислотность сыра, к которому был добавлен Грангал показали более высокие значения в течение первой недели хранения, но более низкие значения после. Настоящий результат предлагает использование добавок; особенно тех, которые традиционно использовались верблюдоводами. Эти добавки являются традиционными и улучшают обработку сыр из верблюжьего молока.

*Ключевые слова: верблюжье молоко, сыр, Грангал, хранение, составляющие*

#### Introduction

The processing of camel milk into cheese difficult and it produces a week soft curd (Ramet, 2001 and El Zubeir and Jabreel, 2008). Benkerroum et al., 2011) demonstrated that cheese making from camel milk can be made providing that the appropriate chymosin concentration was used in addition to starter culture (Hailu et al., 2014). They are also reported the possibility of making cheese from camel milk by coagulating it using ginger crude extract. Similarly Suliman and El Zubeir (2014) found that there were wide varieties of additives used for preparing Gariss; a traditional fermented milk; and that